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OFFICE OF THE BOARD OF STREET COMMISSIONERS,
CITY OF HARTFORD, May 15, 1877.

To the Honorable Court of Common Council of the City of Hartford:

His Honor, Mayor Sprague, in December, 1876, returned to the Court of Common Council, without his approval, a vote laying out a culvert sewer from Edwards street to Albany avenue. The whole matter was thereupon referred back to this Board, together with the special message of the Mayor, recommending that an experienced engineer should be consulted in regard to the best sewerage for the district drained by Gully Brook, especially with the view of excluding sewage from the brook, and also in regard to the necessity and possibility of protecting Park river from pollution by sewage. A resolution of the Court of Common Council, passed in February last, further expressly authorized us to consult an expert in sanitary engineering. Accordingly, the Board invited J. Herbert Shedd, Esq., late Chief Engineer of the Providence Water Works, to visit Hartford and examine the topography of the city, and the difficulties to be overcome. Mr. Shedd arrived here on February 26th, and spent two days with us, and, from the information then obtained, and from such maps, profiles, and figures as we have since been able to furnish him, has made a careful study of the problems involved. The Board also took advantage of Mr. Shedd's visit to submit to him the alleged evils of the present outfall of Franklin avenue sewer, which had been made the ground of an application for relief to the Superior Court, and in respect to which the Court had advised us to ascertain the feasibility of improvement.

Mr. Shedd's report is herewith presented, and requires few comments from us. We submit it in printed form, feeling that it deserves from the public an attentive examination, and we recommend that it be printed in the Municipal Year Book, as

an appendix to the last annual report of this Board, for preservation and future reference.

Mr. Shedd's plan for the removal of Franklin avenue sewage can be decreased in cost probably about \$10,000, by adopting an outlet sewer three feet in diameter instead of four feet. It will be observed that the size of the outlet he suggests is based on the future and not on the present needs of the territory; on its requirements as an urban district, and not while, as to-day, largely unimproved. As to the probability of an extensive increase of streets and buildings within the drainage area of Franklin avenue sewer, opinions will differ. In the present depressed condition of real estate, and especially of vacant and unproductive land, many will be disposed to think that small provision need be made for a populous settlement of all this territory, and will advise an outlet suitable for the present or a slightly increased population. Mr. Shedd wisely, in our judgment, makes ample provision for the future, and lays on us the responsibility of choosing, if we see fit, a possibly inadequate remedy.

But the estimated cost, even if lessened to \$41,000, would be a large expenditure for the city to undertake in one year, unless it were to be assessed upon the persons benefited. Undoubtedly the cost might lawfully be assessed upon those whose drainage makes the extension necessary. But, practically, this would be at present an intolerable burden to those who are already embarrassed by assessments for the existing sewer. If the cost is to be borne by the city at large, it might be possible to distribute the work, and consequently the expense, through two years without serious damage.

To avoid so large an expenditure for this purpose as the lowest sum named, the Board submitted other devices, such as continuing the main sewer or carrying the proposed outlet sewer to the south east, beyond the Valley Railroad track, and taking the sewage thence to the river in an open trench. Folly Brook might also be diverted from the Cove to this trench, and thus increase the flow through it. Mr. Shedd is not willing to recommend this plan as a certain and permanent remedy, but he inclines to think it might answer our purpose for some time, and, if not successful, the outlet sewer could subsequently be

continued across the meadows to Connecticut river. The cost of this partial extension would vary from about \$15,000 to \$31,000, according to the size of the sewer extension and the amount of labor bestowed on the trench

The cost of the intercepting sewer and connections, from Edwards street northerly along the valley of Gully Brook as far as Albany avenue, with the cut-off on Pine street—leaving Capen street sewer the only present nuisance in the brook—as proposed by Mr. Shedd, is estimated at \$13,157. Although this sum is small, compared with the cost of the culvert sewer proposed by this Board, it must be remembered that there will be no land reclaimed by the small sewer. The engineering advantages, however, of the intercepting sewer, and especially its necessity as part of a plan for eventually taking all the sewage of the district to Connecticut river, in channels independent of the natural watercourses, are fully set forth in Mr. Shedd's report. This Board, while not doubting the general correctness of Mr. Shedd's views, at first feared that he underestimated the nuisance caused by the brook itself, which, it seemed to them, must eventually be enclosed. But, after full discussion, they have unanimously agreed in these conclusions, drawn from Mr. Shedd's report: 1st, That it would be altogether inequitable to assess the whole district for the reclamation of land by a large sewer, if a much cheaper sewer will convey all the sewage; and that it would be difficult, if not impossible, to discriminate in assessing two classes of benefit. 2d, That, unless the small sewer is adopted, the difficulty of hereafter attempting the purification of Park river will be greatly enhanced. Further, they have made a preliminary estimate of the benefits to be assessed for the small sewer, in a very general way, but with sufficient care to satisfy themselves that even an assessment of \$13,000—considering the character of much of the property most benefited, and the incumbrances already existing on it—will be as much as can be fairly imposed or actually collected at this time.

The land damages for right of way are not included in the estimated cost of the Gully Brook sewer or the Franklin avenue sewer extension, but in each case they should be very moderate.

Since his report was written, Mr. Shedd has again visited Hartford, and partially examined the drainage of the north-eastern part of the city. Without having made careful estimates, he has no doubt that the Sanford and Windsor streets sewer can be continued southerly through Windsor and North Front streets to Pleasant street, and, crossing the railroad tracks, be carried thence along the bank of Connecticut river to a point near the bridge, thus intercepting all the sewers of that district and depositing their sewage far below the pumping-house of the Water Works, at the same time furnishing a freer outlet for most of them. The cost of such a sewer is roughly estimated at \$35,000.

The Board urge upon members of the City Government, and upon all citizens interested in these matters, a thoughtful consideration of the accompanying report.

Respectfully submitted,

J. C. PARSONS,

Chairman.

PROVIDENCE, April 6, 1877.

JOHN C. PARSONS, Esq.,

Chairman Board of Street Commissioners, Hartford, Conn.

DEAR Sir:—

Having examined the various matters to which you have called my attention, and given them such consideration as the circumstances of the case admit, I will briefly state my conclusions.

FRANKLIN AVENUE SEWER.

The discharge of this sewer, from a drainage area of nine hundred acres, is into a brook leading to Wethersfield cove, and thence to the Connecticut river. The distance through which it flows in open water-course is a little more than a mile, and such objections have arisen to this mode of conveying the sewage as to demand a remedy, either by a change in the mode of conveyance or by an effectual disposal of the sewage in some other unobjectionable manner.

There is a natural feeling growing in the community in favor of restoring to the land those elements of fertility which have been taken from it, and which are usually wasted, to appearance, by being discharged with the sewage into the water-courses, or into the sea. The effort to do this has been made in several places, in other countries, with varying success; and it seems probable that eventually a large part of the fertilizing matter that is now lost to the land will be restored by irrigation or otherwise. But at present such a scheme of irrigation by sewage would, in a measure, be an experiment in this part of the country, where the winter climate is much more severe than in countries where the plan has been tried. As this would involve some system of filtration, under cover, for several months in the year, if the discharge is to be continuously purified,

the necessity of the case should be great to warrant the attempt to carry such a plan into execution under our present knowledge of the subject.

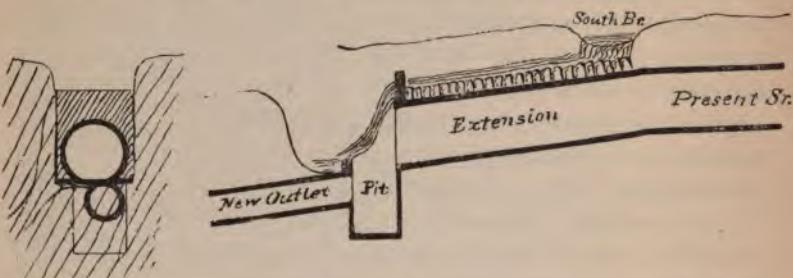
The favorable location of the meadows, across which the brook from the Franklin avenue sewer runs for a distance of about thirty-eight hundred feet on its way to the river, for works of irrigation, suggests the attempt to utilize the sewage in this case. But in addition to the consideration above mentioned, we have the fact that for the present the district is thinly settled, the population being estimated at about 2,000 persons, or a little more than two persons per acre, and the length of travelled streets is also very small when compared with a thickly populated territory. On this account the amount of manorial property, which can be obtained from the sewer, will be very small in comparison with the cost of the works that will be necessary to make it available. From several analyses the value of the Boston sewage has been estimated at one cent per ton, and that of Worcester at seven-eighths of a cent per ton, from which it will be seen that a large body of water must be handled for a small return. A disagreeable odor sometimes arises from sewage irrigated lands, and this, I suppose, would be objectionable from the locality of these meadows. While I think the conditions are not now favorable to a disposal of this sewage by irrigation upon the meadows, I would yet so dispose of it that irrigation may be resorted to at some future time, if it is found to be desirable. This can be done by constructing a sewer of sufficient size to take the liquid refuse from buildings, and the first run of water from the streets in a storm, from the outlet of the main sewer to the river, allowing the excess in heavy storms to overflow into the present brook channel.

What the size of this outlet sewer should be, is a debatable question; though there is no doubt but that it should be larger than is needed simply for taking the liquid refuse from buildings, for the reason that the first wash from the streets in a rain storm, carrying the droppings from animals and other foul matter, is often more offensive than the discharge from water-closeted houses. Any overflow whatever from the main sewer into the brook channel during a storm, will carry, in some degree, a mixture of the foul sewage with the storm waters, and

a line of division between the quantity that can be carried through the outlet sewer, and that which must overflow into the brook, should be drawn so that the amount carried into the brook shall not be practicably objectionable. Upon consideration, I think a sewer four feet in diameter should be provided, from the outlet of the main sewer, to the river, which will have a capacity to carry, when the Connecticut river is not higher than five feet above the city base, a little more than one-sixth the volume that the main sewer must be expected to discharge in such storms as are liable to occur at intervals. This will leave about eighty-two per cent. of the storm waters, at such times, to flow through the present brook channel. Storms that will yield a greater discharge than thus provided for are of rare occurrence, and need not be particularly considered in our construction of an outlet. But few storms in each year would cause an overflow into the brook. In determining upon a size for the outlet sewer, I take into account the future occupation of the territory by buildings and streets. It is possible, and even probable, that I have set the standard of purity for the water that is to overflow into the brook, too high, and if, on thorough examination of all the circumstances, it should be decided that this is the case, the size of the new outlet sewer, and the consequent cost, can be correspondingly reduced.

As the meadows are flooded, sometimes very deeply, by Spring freshets, and large bodies of ice are likely to sweep along the surface, it is desirable to place the sewer below the surface at all points. For this purpose I would locate the inside crown of the sewer at grade five, and run it level from the river to a creek thirty-two hundred feet distant therefrom; thence let the crown rise on a uniform grade towards the invert of the end of the present main sewer. This will, under ordinary circumstances, place the sewer under an internal pressure, which may at one point be equivalent to about twelve feet head of water, which must be provided for in the plan of construction adopted for the sewer. Although this outlet sewer will, when running full, have a velocity about double that which is required to keep it cleansed from deposits of sewage matter, there will be a tendency to gather deposit during a dry weather flow, and it is possible that some means besides the scour of the storms will be required to keep it clean.

The present main sewer should be extended about seven hundred feet on a falling grade of 0.81 per 100, the present canal through the rock-cutting being deepened for that purpose. A pavement should be laid over the crown of this extension, and a bulkhead wall built over the new outlet so that the lateral brook, which enters the canal at the present outlet, may be conveyed over the extended sewer, and deflected around the new outlet into the brook channel. Below the new outlet a chamber and pit should be built, into which the ordinary flow of the main sewer will fall, and in which any heavy matter will settle and remain until taken out. From the upper part of this chamber, the new sewer should take the flow it is designed to carry.



The plan of construction to be adopted for this sewer is a matter of importance. It should be permanent and inexpensive. A cast iron pipe, which would resist the pressure, would be expensive, and liable to the growth of tubercles, which would obstruct the flow. A wooden pipe could not be wholly submerged at all times, and would probably soon decay. A brick conduit, as ordinarily constructed, would be likely to burst when under the greatest pressure. A cement and iron conduit would be liable to destruction by the action of the sewage. As hard-burned bricks, laid close, furnish the most satisfactory conduit of large size, for the conveyance of sewage, I propose to construct the inner portion of the sewer of this material. Around a four-inch ring of brickwork would be laid a close lagging of narrow strips of wood an inch thick, which would be bound to the internal ring by bands of wrought iron, at suitable intervals, drawn tight by screw bolts and nuts. The whole would be enclosed by a body of concrete, six inches in thickness. The iron

bands would furnish full resistance against internal pressure, and the wood and iron, being entirely enclosed from air and water by the brickwork on one side and the concrete on the other, would be practically indestructible. This conduit has the advantage of being permanent, and it is reasonably inexpensive.

A convenient swing gate at the end of the main sewer, and another at the lower end of the outlet sewer, would furnish means of stopping the flow during the cleansing of the pit, and the volume of water thus retained, if properly discharged, would flush the outlet sewer so as to remove most, if not all, the deposit that may have collected. This means of flushing can be repeated as often as necessary, and it would not be expensive. If the flushing should fail to remove the whole of the deposit, another simple and cheap method of effecting it would be to send balls of varying and suitable sizes, of a specific gravity about equal to water, through the sewer. Where the progress of the ball is checked by deposit, the increased velocity of the water, caused thereby, will scour the deposit, sending it forward and allowing the ball to follow, until all has passed through to the outlet.

Four manholes should be constructed along the line of the outlet sewer, for convenience of examination and cleansing.

I estimate the cost of the works above referred to, including engineering and superintendence, as follows:

Extension of main sewer and brook, - - - -	\$9,100
Outlet sewer, - - - -	41,400
Special work—pit, gates, manholes, etc., - - - -	500
Total, if done by the day, - - - -	\$51,000
Contractor's profit, - - - -	6,000
Total, if done by contract, - - - -	\$57,000

The result of this work will be the discharge of the sewage into a volume of water so large as to dilute it to an extent that will render it unobjectionable, at least for many years to come.

GULLY BROOK SEWER.

The Gully Brook drains an area roughly estimated at 1,650 acres, about 400 acres of which is now well occupied by buildings and streets. It is supposed by your City Surveyor that 650 acres is an outside estimate of the area that will be settled in this district twenty-five years hence. The lower portion of the brook channel now passes, for a distance of about 1,850 feet, through a culvert about $9\frac{1}{2}$ feet wide and $8\frac{1}{2}$ feet high, with rough stone side walls, covered by a semi-circular brick arch of 5 feet radius. This culvert is no larger than will be required to carry the waters of the heaviest storms, and its full capacity will be more frequently needed in the future than it has been in the past. It will probably be overcharged at times.

The natural brooks ordinarily furnish such convenient means for ridding neighboring buildings of refuse that they are frequently used for that purpose until, as the number of buildings increases, they gradually become so foul as to create an intolerable nuisance in their open state, and are finally walled in and turned into sewers, to take refuse from far and near, without much consideration as to whether that is the best course to pursue.

But, as an almost universal rule, the natural water-courses should be preserved, as nearly as possible, in their original purity, and the channels for the conveyance of ordinary liquid refuse should be independent, and constructed for that purpose alone.

The rain water, which first washes the surfaces of much traveled streets, becomes very foul, and should therefore be turned into the sewers proper. But such sewers cannot, when draining a large territory, have their greatest efficiency for ordinary conditions when constructed large enough to take all the rain water from heavy storms. For these reasons it becomes necessary, at times, to make use of the brook channels in connection with the sewers, to secure the most efficient and satisfactory system of sewerage. Such a combined system secures, in nearly every case, the greatest economy also, as the sewers of a size sufficient for carrying the ordinary storm flow can

still have such a cross-section as to secure self-cleansing conditions, thus avoiding the expense of cleaning by manual labor, as well as the dangers which arise from a putrifying mass of refuse lying stagnant in the sewers; and, being small, they can be constructed at much less cost than would be required to enclose the brook channels in masonry, with sufficient capacity to convey the rainfall of heavy storms.

Even when the entire drainage area of a brook has become urban territory, the sewers need not ordinarily be more than one-fifth as large as is required for all the storm-waters, and often a smaller size will answer the purpose. But in the case under consideration the urban territory will be only about 45 per cent. of the whole drainage area, at the end of the next quarter of a century, even if we assume 750 acres to be occupied instead of 650 as estimated by the City Surveyor. The sewer proper will then be of sufficient capacity if it is 9 per cent. of that which would be required for the covered brook channel, if this were prepared to take the sewage. In other words, the culvert to take the brook and sewage together would need to be eleven times the capacity required for a sewer to take all the sewage and the water, from the urban district, of an average rainfall, or the proportion of a heavier rainfall required to cleanse the streets. After the streets have been cleansed, the excess of rainfall may, without objection in ordinary cases, be allowed to overflow into the brook channel.

If, in the development of the area for building purposes, it becomes desirable to lessen the space occupied by the brook, during storms, the cost of the work should be borne by those who have their lands reclaimed, rather than assessed upon all the occupants of the drainage area.

When the channel of a natural water-course is narrowed, the bed should be deepened to an equivalent degree; otherwise, the floods will rise higher than formerly, and flood lands that have before been free from that disadvantage. In this case, it is unfortunate that the bottoms of the culverts were not laid lower, at the street crossings, as in some, if not all the streets, the lateral sewers enter the culverts at the bottom, and every time a freshet fills the brook, these sewers are backed up some six or seven feet deep above their outlets, and cellars, when connected with the

sewers, will be likely to be flooded. It is better to lay all sewers so that the grades of the crowns run together without break, and then the sewers can flow full of water without backing water upon those which discharge into them. Probably it will be an economical measure to relay these detached culverts when the brook channel is permanently improved.

Upon examination of the Gully Brook district, I find no sufficient reason for making it an exception to the general rule requiring an intercepting sewer for the ordinary flow, and the preservation of the brook.

There will be especial advantage in collecting the sewage of the Gully Brook district into a small intercepting sewer, as, in that way, a very much greater proportion of the filth from this large territory can be taken on to the Connecticut river by an intercepting sewer, designed to prevent the discharge of sewage into Park river, than would be otherwise possible without greatly increasing the size and cost of the sewers in the Park river system of interception.

The present foul condition of Gully Brook does not result solely from the liquid refuse which is turned into it, but, in a measure, from solid matters, for which it is a catch-all. An intercepting sewer will not, of course, furnish a remedy for filth of this character, but, after provision is made for taking off the liquid refuse, it will be practicable to enforce proper regulations for keeping out objectionable solid matter. Without provision for the liquid refuse, regulations against fouling the brook by other matters would be of little value.

Under the plan I recommend, the brook can be restored to a reasonable state of purity, which may be economically maintained.

The location of the intercepting sewer for the Gully Brook district should be on the westerly side of the Connecticut Western Railroad, from Edwards street to Asylum street, through Spruce street. Between Asylum street and Park river, the location would depend upon the line of the sewer designed to protect Park river from contamination. The construction of this portion of the sewer—from Edwards street to Park river,—might, perhaps, be delayed until the outlet along Park river is completed.

There is no convenient street, between Edwards and Liberty, for the location of an intercepting sewer, and a line through private property, crossing the brook and running near to it, but in a more direct course, should be adopted. From Liberty street to Albany avenue, the sewer may be laid in the middle of the street recently laid out, nearly in continuation of Brook street.

This location of the sewer, together with the construction of a sewer in Brook and Pine streets, about three hundred feet in length, connecting with the Pine street sewer, to take the ordinary flow from that street, will enable you to keep out nearly all the ordinary sewage that now flows into Gully Brook, except that from a single line in Capen street, which is, perhaps, not sufficiently objectionable to require immediate attention. Probably the interception of the sewage from Capen street may be delayed for a long time by turning the flow over the grass land near the brook, during the growing season.

When it becomes necessary to extend the sewer beyond the junction of Albany avenue and Brook street, it should be constructed, I think, in Albany avenue and Garden street to the point where the brook now crosses the latter street. Beyond this point I have not thought it necessary to pursue my investigations at the present time, for the purpose of determining the most suitable location for the sewer. An ordinary street sewer might be laid in Garden street, tapping the present sewer in Capen street, if thought desirable.

The bed of the brook from Capen street to Edwards street, has an average fall of one foot in two hundred and seventy-five, which can be made uniform without much difficulty. If the grade of the sewer is made the same as the average grade of the brook, the size of that portion to be constructed between Edwards street and Walnut street should be equivalent to a circle of forty-four inches diameter. The size of that portion between Walnut street and Albany avenue should be equivalent to a circle of forty inches diameter. If the sewer is laid in Albany avenue and Garden street, from Brook street to the brook-crossing on Garden street, it should be equivalent, in size, to a circle of thirty inches diameter. Between Garden street and Capen a circular sewer, twenty-four inches in diameter, would be suitable if laid near the brook channel and on a similar grade.

Overflows must be constructed at intervals to pass the excessive storm waters from the sewer into the brook channel.

I have not sufficient data from which to make an entirely accurate estimate of the cost of a sewer, and appurtenances, from Albany avenue to Edwards street; but, having designed each detail for this purpose, I have carefully prepared, from the best information available, the following estimate of cost, which includes engineering and superintendence:

44-inch sewer from Edwards street to Walnut street,	-\$5,910.00
40-inch sewer from Walnut street to Albany ave.,	5,947.00
Special work, including brook crossings, twelve man-holes, three overflows and a large trap at Edwards street,	785.00
Sewer in Brook and Pine streets,	515.00
Total,	\$13,157.00

POLLUTION OF PARK RIVER.

Much that has been said in regard to the Franklin avenue outlet and the Gully Brook sewer, is applicable, in a measure, to the case of Park River. The stream is now very much polluted, and it must necessarily become more foul as the amount of sewage discharged into it is increased, until a remedy is applied.

It is clear that the purity of the water should, in this case, be preserved by preventing the flow of sewage into it. The immense preponderance of country territory, in the drainage area, over that occupied by buildings, precludes the idea of converting this stream into a covered sewer.

Owing to the great difference between the volume of water flowing during the wet season and that flowing in the dry months of summer, any scheme for so improving the bed of the stream as to prevent the deposit of filth on those portions which are exposed in summer, would be difficult and uncertain of satisfactory accomplishment. So long as the sewage is confined to the stream, and the deposits are covered with a good depth of

flowing water, the stream may become offensive to sight without necessarily being unhealthy in its effect upon the air of the neighborhood; but when the foul deposits are exposed to the air and sun, the process of putrefaction becomes rapid, and a very unhealthy condition may exist.

If any scheme of sewage utilization is satisfactorily accomplished in the future, the material to be disposed of can be most readily secured when gathered in small conduits unmixed with an excessive volume of water. I consider it desirable, therefore, to collect the sewage now discharged into Park river in one or more intercepting sewers, which shall convey the ordinary flow on to the Connecticut river in the most feasible lines.

A thorough knowledge of the ground and all the attending circumstances of a case is necessary to the proper planning of any important engineering work, and in this case your surveyor is not in possession of sufficient data, at present, to enable me to sketch a suitable scheme for such intercepting sewers; but I think the drainage from both sides of Park river, on the most of its course through the city, can be advantageously turned into one sewer, with suitable overflows for the discharge of excessive storm waters. For this purpose it would be necessary, sometimes, to cross the river with sewers, and perhaps to run for some distance in the bed, parallel with the general course of the stream.

With my present information, I believe this general plan will be much more economical than any other satisfactory plan for restoring Park River to a proper state of purity, and that it can be accomplished at reasonable cost.

Respectfully submitted,

J. HERBERT SHEDD.

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